Shoulder instability

Assessment of anterior-posterior translation with a knee laxity tester

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We developed a simple method to measure the anterior-posterior (AP) translation of the shoulder joint: by positioning the Donjoy® Knee Laxity Tester horizontally over the shoulder girdle, the AP translation was measured after applying a standardized sagittal force.

Measurement of AP-translation during two tests on the same shoulder was reproducible with an intraclass correlation coefficient (ICC) of 0.996.

In normal subjects the mean side difference was 0.6 mm, corresponding to a p-value of 1.00. In patients with unilateral instability AP-translation was significantly larger on the injured shoulder. Furthermore, the intraindividual differences in AP-translation were significantly larger in patients with unilateral instability than in normal subjects. Individuals with multidirectional instability had significantly higher values than any of the other groups.

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There is an increasing interest in complex glenohumeral instabilities. Evaluation of these patients requires an easily applicable and reproducible device for assessment of shoulder instability. The Donjoy® Knee Laxity Tester has been used to evaluate cruciate ligament-deficient knees, and its value and reproducibility are well documented (Boniface et al. 1986, Steiner et al. 1990). We evaluated the ability and the reproducibility of the Donjoy® Laxity Tester to assess anterior-posterior (AP) translation of the shoulder joint.

Patients and methods

Procedure

The patient sits on a couch with relaxed arms. The Laxity Tester (LT) is placed transversely on the upper anterior part of the chest solidly supported by the clavicles, the support pole being centered 2 cm medial to the acromioclavicular joint (Figure 1). The spring balance is centered over the humeral head and the LT is fixed with 2 rubber bands around the shoulder girdles, while the arms are anchored to the trunk distally by a rigid sling applied above the elbow joint. The humerus is held in neutral rotation, the forearms resting with the elbow flexed at 90° and the thumbs up. The investigator fixes the scapula with his thumb and index finger at the acromion, and using a dynamometer, a sagittal force of 20 lbs (89 N) is applied anteriorly and posteriorly at an angle of 15 degrees to the sagittal plane. Anterior load is applied with the dynamometer high in the axilla, using the axillary fold as a fix-point, and posterior load is applied with the dynamometer in front of the axilla. The AP-translation is measured by reading the scale on the spring balance at intervals of 0.5 mm. A test consists of 3 repeated anterior measurements, followed by 3 posterior measurements. The sum of the 2 median values is noted as the AP-translation.

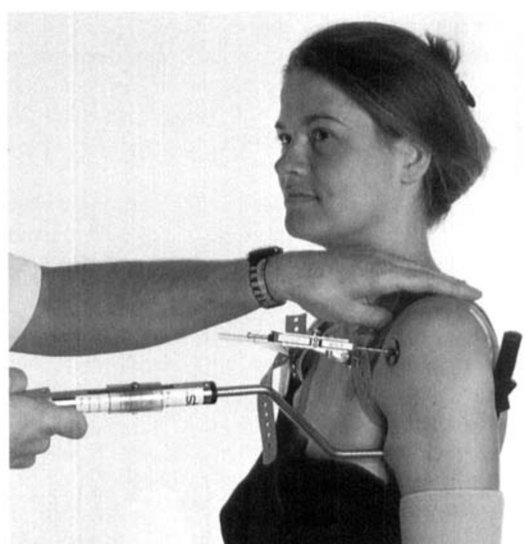
Figure 1. Test position of the laxity tester before measurement of anterior translation.

Table 1. Clinical data and results of assessment of AP-translation with the Laxity Tester. Age given in median and range, translation measures in mean *SD*

Group	Sex (F/M)	Age	AP-left mm	AP-right mm	dAP mm	P
I	5/5	25 (15–40)	2.1 *1.7*	2.1 *1.7*	0.6 *0.5*	1.0[a]
II	3/7	30 (18–49)	6.4 *3.6*	2.8 *2.9*	3.6 *2.0*	0.008[b]
III	5/5	23 (16–45)	5.8 *2.6*	3.2 *2.0*	2.6 *1.8*	0.02[b]
IV	9/1	24 (18–45)	11.9 *6.3*	11.0 *6.4*	2.3 *2.1*	0.4[a]

[a]Wilcoxon test for paired data
[b]Mann-Whitney test for unpaired data

Reproducibility

To assess the reproducibility of the measurements, a test-retest series was performed on 40 shoulders in 20 subjects, median age 27 (15–49) years. The group consisted of normal subjects among the hospital staff and patients seen in the outpatient clinic with known instability. After performing the test, the LT was removed, repositioned and a retest was made. Reproducibility between the mean values of test and retest was evaluated with the intraclass correlation coefficient (ICC) (Fleiss 1986, Snedecor and Cochran 1967). The reliability is excellent when r is > 0.75 (Fleiss 1986).

Identification of intra- and interindividual differences in AP-translation

The second part of the investigation concerned the ability to measure intra- or interindividual differences in translation in 4 groups (Table 1). Group I consisted of 10 patients, median age 25 (15–40) years, with bilateral healthy shoulders. Group II consisted of 10 patients, median age 30 (18–49) years, with a history of a unilateral, traumatic anterior dislocation of the shoulder joint. The time from injury to examination was a median of 4 (0.5–11) years. Group III consisted of 10 overhand athletes, median age 23 (16–45) years who had no history of traumatic dislocation, but unilateral pain and a sensation of instability during overhead activity. All had a positive apprehension test at 90 degrees abduction (Rowe and Zarins 1981) and a positive draw test (Hawkins and Bokor 1990). Group IV consisted of 10 persons, median age 24 (18–45) years, with atraumatic multidirectional instability due to generalized joint hyperlaxity. A minimum of 4 of 5 criteria (Table 2) was needed to enter this group. For patients in groups I and IV, the difference in translation between the right and left shoulders was calculated as the absolute value of the difference in translation. For patients with known instability (groups II and III) the difference in translation was calculated by subtracting the value of the healthy shoulder from that of the injured shoulder.

Table 2. Carter and Wilkinson's criteria for general joint hypermobility (1964)

1. Hyperextension of the elbow > 10°
2. Hyperextension of the knee > 10°
3. Passive apposition of the thumb to the volar aspect of the forearm (< 1/2 cm)
4. Passive hyperextension of 2nd to 5th fingers >90° or parallel to the forearm
5. Dorsiflexion of the ankle > 45°

If more than 3 criteria are met, the person is generally hypermobile. If all 5 criteria are met, hypermobility is severe.

Non-parametric statistical analysis was performed, and data were considered to be of rank ordinal type. Stability data from shoulders in normals (group I) and in hypermobile subjects (group IV) were considered to be paired and were analyzed with the Wilcoxon test. In patients with unilateral instability (groups II and III), stability data of the injured and the healthy shoulders were considered to be unpaired, as only the injured shoulder undergoes an event, and statistical analysis was performed with the Mann-Whitney test. An alpha level < 0.05 was considered significant.

Results

In the following, all mean values are followed by *SD*.

Reproducibility

AP-translation was 3.02 *2.24* mm for the first measurement and 3.30 *2.27* mm for the repeated measurement, showing a high reproducibility (intraclass coefficient r 0.996).

Intra- and interindividual differences in AP-translation (Table 1)

In normal shoulders (group I), the intraindividual difference in AP-translation was a mean of 0.6 *0.5* mm. In patients with atraumatic, multidirectional instability (group IV), the values of AP-translation in the right shoulder compared to the left differed, but were without significance. In patients with unilateral, unidirectional instability (group II and group III), there was a significant difference in AP-translation compared to the healthy shoulder (Table 1).

There was a highly significant interindividual difference in AP-translation (dAP) between normals and patients with traumatic dislocation and between normals and patients with atraumatic instability. The values of AP-translation in hypermobile shoulders were significantly larger than in normals, in patients with traumatic dislocation and in patients with non-traumatic, unilateral instability (all p-values for these comparisons ≤ 0.002) (Table 1).

Discussion

Our method has a high reproducibility and it is easy to use. However, in our study 5 patients could not be examined because the LT spring balance and support pole did not fit well enough to perform the test properly. The device might be improved slightly to better fit the shoulder girdle.

Unlike in other instability tests used in the unanesthetized patient the applied sagittal, translational force is standardized making interindividual observations valid. Two limitations of the method are that translation testing is carried out in one plane only, and that the examination is performed with an adducted arm. This test position, however, is analogous to the test position in the draw test (Hawkins and Bokor 1990).

We prefer the patient in a sitting position during the test, which relates better to the normal body posture. Some authors prefer to have the patients in supine position, but this may not reveal the true degree of anterior instability, since the humeral head in the resting position will tend to move downwards posteriorly due to gravity. This possible source of error may be more pronounced when examining anesthetized persons, with relaxed dynamic stabilizers of the joint. Moreover, measurement of posterior translation may be less safe since the humeral head may be posteriorly translocable up to 50%, even in healthy shoulders (Norris 1985, Papilion and Shall 1992).

Clinical shoulder translation is an expression of a combined movement of the glenohumeral, the scapulothoracic and the sternoclavicular joints and, to a lesser degree, the acromioclavicular joint. A concomitant glide in the scapulothoracic joint has been described, in particular, when testing for posterior translation under anesthesia (Gerber and Ganz 1984, Norris 1985, Papilion and Shall 1992). In our set-up of shoulder laxity testing, the support pole fixes the clavicles bilaterally and thus restricts movement of the sternoclavicular joints. Furthermore, the examiner holds the acromion to limit scapulothoracic joint motion. The thickness of the deltoid muscle and the subcutaneous tissue, however, may influence the results.

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